PROCEEDINGS

OF

THE ROYAL SOCIETY.

1831–1832. No. 8.

December 8, 1831.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, K.G., President, in the Chair.

Thomas Maclear, Esq., Philip Hardwick, Esq., the Right Hon. Lord Oxmantown, and Henry Robinson Palmer, Esq., were elected Fellows of the Society.

The reading of a paper, entitled "Experimental Researches in Electricity," by Michael Faraday, Esq. F.R.S. was commenced.

December, 15, 1831.

JOHN WILLIAM LUBBOCK, Esq. M.A., V.P. and Treasurer, in the Chair.

The reading of Mr. Faraday's paper, entitled "Experimental Researches in Electricity," was concluded.

This paper is divided into four parts: the first being on the Induction of Electric Currents; the second, on the Evolution of Electricity from Magnetism; the third, on a new Electrical Condition of Matter; and the fourth, on Arago's Magnetic Phænomena.

The author defines *electrical induction* to be the power which electrical currents possess of *inducing* any particular state upon matter in their immediate neighbourhood. A great length of copper wire, 1-20th of an inch in diameter, was wound round a cylinder of wood so as to compose two helices, the coils of which were intermixed, but prevented from touching each other by interposed threads of twine and calico. One helix was connected with a voltaic battery, and the other with a galvanometer. No effect was perceived on the latter, with a battery of 10 plates: a slight effect only with one of 100 plates; and a distinct deflection of the needle of the galvanometer occurred when the contact was made with a battery of 120 plates. While the contact was preserved, the needle returned to its natural position, and was unaffected by the electric current passing through the wire connected with the battery; but on breaking the connexion, the needle of the galvanometer was again deflected, but in a direction contrary to that of its former deflection. Hence it is inferred that the electric current sent by the battery through one

wire, induced a similar current through the other wire, but only at the moment the contact was made; and a current in the contrary direction when the passage of the electricity was suddenly interrupted. These transitory currents, resembling waves, were found to be capable of magnetizing needles placed within the helix. Collateral currents, either in the same or in opposite directions, exert no permanent inductive power on each other.

No other evidence of the electric action of these induced currents could be detected, such as the appearance of a spark, the ignition of fine wires, or of charcoal, impressions on the tongue, contractions in the muscles of frogs, or chemical decompositions. Yet these induced currents were found to be capable of passing through fluids, when interposed to a small extent in the circuit.

Similar effects were apparently produced by the inductive influence of ordinary electricity directed through the first set of wires.

The second part of this paper contains the account of experiments in which the helix connected with the voltaic battery was wound round one side of an iron ring, welded from soft round bar-iron; while another helix connected with a galvanometer was coiled round the opposite side of the ring. The electrical indications obtained by this apparatus were much more considerable than in the former case, but were equally transitory, and were of opposite kinds on the interruption of the contacts with the battery. By interposing charcoal points in the circuit of the induced helix, a minute spark was perceived whenever the contacts were made or broken off; but no ignition of wires or other electric effects could be obtained. Electric currents were also induced in a helix into which a soft iron cylinder was introduced, whenever that iron was rendered magnetical by induction from magnets applied to its ends. The sudden introduction or removal of a magnet, in the place of the iron cylinder, produced similar effects on the helix.

In many of these experiments the author employed the large compound magnet constructed by Dr. Gowin Knight, and belonging to the Royal Society. Similar effects were produced when the iron was surrounded by a piece of copper-plate wrapped once round it with its edges connected with the wires of the galvanometer. Currents were induced on a wire coiled into a flat spiral, by bringing one of the poles of the powerful magnet of Dr. Knight opposite to its centre. Even single wires brought near the pole of this magnet had electric currents induced in them. But all attempts to obtain chemical effects by these currents of electricity induced by magnetism were unsuccessful.

In the third part of the paper the author regards the condition in which a conducting wire exists while it is subject either to volta-electric, or magneto-electric induction, as a peculiar one, which he designates by the term *Electro-tonic state*. This peculiar condition shows no electrical effects while it continues, nor does it exert any sensible action on matter, or on other electrical currents, either of an attractive or repulsive kind; nor does it tend either to accelerate or to retard those currents.

In the fourth part of the paper the author relates a great number of experiments, which concur in proving that when a piece of metal is moved in any particular direction, either in front of a single magnetic pole, or between the opposite poles of a horse-shoe magnet, electrical currents are developed which pass along the substance of the metal in a direction transverse to that of its own motion. By the application of this principle, the author is enabled to explain the various phænomena which take place in the experiments of Arago and others, where magnetic action appears to be developed by rotation; and which have been erroneously attributed to simple magnetic induction, and to the time supposed to be required for the progress of that induction. The electro-magnetic effect of the electric current induced in a conductor by a magnetic pole, in consequence of their relative motion, is such as tends continually to diminish that relative motion; that is, to bring the moving bodies into the state of relative rest; so that if the one be made to revolve by an extraneous force, the other will tend to revolve with it in the same direction, and with the same velocity.

A paper was read, entitled "Some Remarks on the internal Structure of the Platypus Anatinus (*Ornithorhyncus paradoxus*, Blum.)." By Richard Griffin, Esq. Communicated by Dawson Turner, Esq. F.R.S.

Having an opportunity of examining two specimens of the Ornithorhyncus, the one male, the other female, belonging to the Norfolk and Norwich Museum, the author found in the latter two large mammary glands, one on each side of the chest, and covering nearly the whole under surface of the animal; numerous ducts proceeded from them, perforating the skin, at two circular portions, which presented no elevation corresponding to nipples. The Fallopian tubes terminate by very small orifices in the cloaca: posterior to their terminations the author observed two slightly projecting processes, containing each the orifice of a duct which proceeds to a length of at least two inches, but the continuation of which could not be traced in the specimen examined in consequence of the injuries it had received. In the male, three pointed processes were noticed at each extremity of the corpora cavernosa of the penis, the cavities of which do not communicate with one another, and are separated before their termination. The spur of the male is furnished with a sac, of the size of a pea, containing a poisonous fluid, which by means of a canal is conducted into a wound inflicted by the spur.

December 22, 1831.

HIS ROYAL HIGHNESS THE DUKE OF SUSSEX, K.G., President, in the Chair.

The Right Hon. Sir James Graham, Bart. was elected a Fellow of the Society.

A paper was read, entitled "Some Account of a New Volcano in